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Elemental abundance differences in the 16 Cygni binary system: a signature of gas giant planet formation?

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The atmospheric parameters of the components of the 16Cygni binary system, in which the secondary has a gas giant planet detected, are measured accurately using high quality observational data. Abundances relative to solar are obtained for 25 elements with a mean error of 0.023 dex. The fact that 16CygA has about four times more lithium than 16CygB is normal considering the slightly different masses of the stars. The abundance patterns of 16CygA and B, relative to iron, are typical of that observed in most of the so-called solar twin stars, with the exception of the heavy elements (Z>30), which can, however, be explained by Galactic chemical evolution. Differential (A-B) abundances are measured with even higher precision (0.018 dex, on average). We find that 16CygA is more metal-rich than 16CygB by 0.041+/-0.007 dex. On an element-to-element basis, no correlation between the A-B abundance differences and dust condensation temperature (Tc) is detected. Based on these results, we conclude that if the process of planet formation around 16CygB is responsible for the observed abundance pattern, the formation of gas giants produces a constant downwards shift in the photospheric abundance of metals, without a Tc correlation. The latter would be produced by the formation of terrestrial planets instead, as suggested by other recent works on precise elemental abundances. Nevertheless, a scenario consistent with these observations requires the convective envelopes of 1 Msun stars to reach their present-day sizes about three times quicker than predicted by standard stellar evolution models.

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